I, the undersigned, who have prepared English translation which is attached herewith, hereby declare that the aforementioned translation is true and correct translation of officially certified copy of the Korean Patent Application No. 10-2003-0084556 filed on November 26, 2003.

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KOREAN INTELLECTUAL PROPERTY OFFICE

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Applicant(s):	SAMSUNG ELECTRONICS CO., LTD.

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APPLICATION FOR PATENT

To the Commissioner of
the Korean Intellectual Property Office

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TITLE: APPARATUS AND METHOD OF CONVERTING IMAGE SIGNAL FOR SIX COLOR DISPLAY DEVICE, AND SIX COLOR DISPLAY DEVICE HAVING OPTIMUM SUBPIXEL ARRANGEMENT

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Submitted herewith is an application identified above pursuant to Article 42 of the Patent Act.

[ABSTRACT OF THE DISCLOSURE]

[ABSTRACT]

The present invention relates to an apparatus and method of converting image signal for display device, and more particularly relates to an apparatus and method of converting three-color signal to six-color signal.

A method of converting image signals for a display device including six-color subpixels according to an exemplary embodiment of the present invention is provided, which includes: classifying three-color input image signals into maximum, middle, and minimum; decomposing the classified signals into six-color components; determining a maximum among the six-color components; calculating a scaling factor; and extracting six-color output signals.

Accordingly, the device and the method for converting three-color input image signals to six-color output image signals may provide increased luminance and concentration to a high quality TV.

[REPRESENTATIVE DRAWING]

Fig. 4

[INDEX]

Color, Primary color, Converting, Scaling, Mixed color, Pure color, Cyan, Magenta, Yellow, Complementary color

[SPECIFICATION]

[TITLE OF THE INVENTION]

APPARATUS AND METHOD OF CONVERTING IMAGE SIGNAL FOR SIX COLOR DISPLAY DEVICE

[BRIEF DESCRIPTION OF THE DRAWINGS]

Fig. 1 is a block diagram of an LCD according to an embodiment of the present invention.

Fig. 2 is an equivalent circuit diagram of a subpixel of an LCD according to an embodiment of the present invention.

Fig. 3 is a table for illustrating the two conversion method according embodiments of the present invention.

Fig. 4 is a flow chart illustrating the conversion of the image signals.

Fig. 5 is a diagram for illustrating the process of being decomposed into six color components.

Fig. 6 is a block diagram of a signal modifier according to an embodiment of the present invention.

[DETAILED DESCRIPTION OF THE INVENTION]

[OBJECT OF THE INVENTION]

[FIELD OF THE INVENTION AND PRIOR ARTS OF THE FIELD]

The present invention relates to an apparatus and method of converting image signal for six color display device, and more particularly relates to a liquid crystal display having six-color subpixels.

Recently, flat panel displays such as organic light emitting displays, plasma display panels, and liquid crystal displays are widely developed.

The plasma display panel (PDP) is a device which displays characters or images using plasma generated by a gas-discharge, and the organic light emitting display (OLED) is a device which displays characters or images by applying an electric field to specific light-emitting organics or high molecule materials.

The liquid crystal display (LCD) is a representative of the flat panel displays. The LCD includes a liquid crystal (LC) panel assembly including two panels provided with two kinds of field generating electrodes such as pixel electrodes and a common electrode and a LC layer with dielectric anisotropy interposed therebetween. The variation of the voltage difference between the field generating electrodes, i.e., the variation in the strength of an electric field generated by the electrodes changes the transmittance of the light passing through the LCD, and thus desired images are obtained by controlling the voltage difference between the electrodes.

The flat panel display includes a plurality of pixels including three sub-pixels representing red, green and blue colors.

[PROBLEMS TO BE SOLVED OF THE INVENTION]

However, the three primary color system has a limit for some ranges of colors such as high concentration cyan. This may be overcome by using cyan as one of primary colors. However, the addition of cyan may decrease the luminance of the display device. In order to solve this problem, magenta and yellow as well as cyan are added to primary colors to form a six primary color

system.

Therefore, the present invention relates to an apparatus and method of converting three-color signal to six-color signal.

[STRUCTURES OF THE INVENTION]

In order to solve the object, a method of converting image signals for a display device including six-color subpixels is provided, which includes: classifying three-color input image signals into maximum, middle, and minimum; decomposing the classified signals into six-color components; determining a maximum among the six-color components; calculating a scaling factor; and extracting six-color output signals. The three-color signals may include red, green and blue signals and the six-color signals may include red, green, blue, cyan, magenta, and yellow signals.

The decomposition may include: expressing a predetermined number of terms of coordinates with coefficients. The coefficients may include first to third coefficients expressed as the maximum, middle, and minimum, and the coordinates may be assigned to the six-color signals. The six-color components may include a first term expressed as a multiplication of the first coefficient and first to sixth coordinates, a second term expressed as a multiplication of the second coefficient and the first, second, and sixth coordinates, and a third term expressed as a multiplication of the third coefficient and the first coordinate. The six-color components may include a first term expressed as a multiplication of the first coefficient and first to sixth coordinates, a second term expressed as a multiplication of the second coefficient and the sixth coordinate, and a third term expressed as a

multiplication of the third coefficient and the first coordinate. The first to the third terms may be further decomposed into the first to sixth coordinates to be expressed as a multiplication of fourth to ninth coefficients and first to sixth coordinates.

The calculation of the scaling factor may include: determining a maximum among the coefficients; and calculating a ratio of the maximum among the fourth to ninth coefficients and the maximum among the three-color signals to determine the scaling factor. The scaling factor may be equal to or larger than one.

The extraction of the six-color signals may include: multiplying the scaling factor to the fourth to ninth coefficients.

A device of converting image signals for a display device including six-color subpixels is provided, which includes: a signal controller converting three-color input signals into six-color output signals; a gray voltage generator generating a plurality of gray voltages; and a data driver converting into the six-color signals into data voltages selected among the gray voltages and supplying the data voltages to the subpixels, wherein the signal controller comprises: a magnitude comparator comparing the three-color signals; a decomposer decomposing the three-color signals into six-color components; a scaler calculating a scaling factor based on signals from the magnituded comparator and the decomposer; and a signal extractor multiplying the scaling fact to the six-color components.

The three-color signals may include red, green and blue signals and the six-color signals may include red, green, blue, cyan, magenta, and yellow

signals.

The scaling factor may be defined as a ratio of the maximum among the six-color components and the maximum among the three-color signals. The signal extractor may obtain increments by multiplying the scaling factor to the six-color components.

The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which embodiments of the invention are shown.

Fig. 1 is a block diagram of an LCD according to an embodiment of the present invention, and Fig. 2 is an equivalent circuit diagram of a subpixel of an LCD according to an embodiment of the present invention.

Referring to Fig. 1, an LCD according to an embodiment includes a LC panel assembly 300, a gate driver 400 and a data driver 500 that are connected to the panel assembly 300, a gray voltage generator 800 connected to the data driver 500, and a signal controller 600 controlling the above elements.

Referring to Fig. 1, the panel assembly 300 includes a plurality of display signal lines G1-Gn and D1-Dm and a plurality of subpixels connected thereto and arranged substantially in a matrix. In a structural view shown in Fig. 2, the panel assembly 300 includes lower and upper panels 100 and 200 and a LC layer 3 interposed therebetween.

The display signal lines G1-Gn and D1-Dm are disposed on the lower panel 100 and include a plurality of gate lines G1-Gn transmitting gate signals (also referred to as scanning signals), and a plurality of data lines D1-Dm transmitting data signals. The gate lines G1-Gn extend substantially in a row

direction and substantially parallel to each other, while the data lines D1-Dm extend substantially in a column direction and substantially parallel to each other.

Each subpixel includes a switching element Q connected to the signal lines G1-Gn and D1-Dm, and a LC capacitor CLC and a storage capacitor CST that are connected to the switching element Q. If unnecessary, the storage capacitor CST may be omitted.

The switching element Q including a TFT is provided on the lower panel 100 and has three terminals: a control terminal connected to one of the gate lines G1-Gn; an input terminal connected to one of the data lines D1-Dm; and an output terminal connected to both the LC capacitor CLC and the storage capacitor CST.

The LC capacitor CLC includes a pixel electrode 190 provided on the lower panel 100 and a common electrode 270 provided on an upper panel 200 as two terminals. The LC layer 3 disposed between the two electrodes 190 and 270 functions as dielectric of the LC capacitor CLC. The pixel electrode 190 is connected to the switching element Q, and the common electrode 270 is supplied with a common voltage Vcom and covers an entire surface of the upper panel 200. Unlike Fig. 2, the common electrode 270 may be provided on the lower panel 100, and both electrodes 190 and 270 may have shapes of bars or stripes.

The storage capacitor CST is an auxiliary capacitor for the LC capacitor CLC. The storage capacitor CST includes the pixel electrode 190 and a separate signal line, which is provided on the lower panel 100, overlaps the

pixel electrode 190 via an insulator, and is supplied with a predetermined voltage such as the common voltage Vcom. Alternatively, the storage capacitor CST includes the pixel electrode 190 and an adjacent gate line called a previous gate line, which overlaps the pixel electrode 190 via an insulator.

For color display, each subpixel uniquely represents one of primary colors (i.e., spatial division) or each subpixel sequentially represents the primary colors in turn (i.e., temporal division) such that spatial or temporal sum of the primary colors are recognized as a desired color. Fig. 2 shows an example of the spatial division that each subpixel includes a color filter 230 representing one of the primary colors in an area of the upper panel 200 facing the pixel electrode 190. Alternatively, the color filter 230 is provided on or under the pixel electrode 190 on the lower panel 100.

An example of a set of the primary colors includes red, green, and blue colors or complementary colors thereof, i.e., cyan, magenta, and yellow colors.

The above-described six colors is referred to as six primary colors hereinafter, and red, green and blue colors are referred to as first three primary colors, while cyan, magenta, and yellow colors are referred to as second three primary colors. The six primary colors preferably satisfy the positions at the color coordinates defined by TABLE.

Red	Red, Redish-Orange
Green	Green
Blue	Blue, Purplish Blue, Bluish-Purple
Cyan	Bluish-Green, Blue-Green, Greenish Blue
Magenta	Red-Purple, Redish-Purple, Purplish-Pink, Redish-Purple, Purple
Yellow	Yellow, Orange, Yellowish-Orange, Greenish-Yellow, Yellow-Green

TABLE is quoted from Billmeyer and Saltzman, Principles of Color Technology, 2nd Ed., John Wiley & Sons, Inc., pp.50.

One or more polarizers (not shown) are attached to at least one of the panels 100 and 200.

Referring to Fig. 1 again, the gray voltage generator 800 generates two sets of a plurality of gray voltages related to the transmittance of the subpixels. The gray voltages in one set have a positive polarity with respect to the common voltage Vcom, while those in the other set have a negative polarity with respect to the common voltage Vcom.

The gate driver 400 is connected to the gate lines G1-Gn of the panel assembly 300 and synthesizes the gate-on voltage Von and the gate-off voltage Voff from an external device to generate gate signals for application to the gate lines G1-Gn.

The data driver 500 is connected to the data lines D1-Dm of the panel assembly 300 and applies data voltages, which are selected from the gray voltages supplied from the gray voltage generator 800, to the data lines D1-Dm.

The drivers 400 and 500 may include at least one integrated circuit (IC) chip mounted on the panel assembly 300 or on a flexible printed circuit (FPC) film in a tape carrier package (TCP) type, which are attached to the LC panel assembly 300. Alternately, the drivers 400 and 500 may be integrated into the panel assembly 300 along with the display signal lines G1-Gn and D1-Dm and the TFT switching elements Q.

The signal controller 600 controls the gate driver 400 and the gate driver 500.

Now, the operation of the above-described LCD will be described in detail.

The signal controller 600 is supplied with input three-color image signals R, G and B and input control signals controlling the display thereof such as a vertical synchronization signal Vsync, a horizontal synchronization signal Hsync, a main clock MCLK, and a data enable signal DE, from an external graphics controller (not shown). After generating gate control signals CONT1 and data control signals CONT2 and converting and processing the input image signals R, G and B into six-color image signals R', G', B', C, M and Y suitable for the operation of the panel assembly 300 on the basis of the input control signals and the input image signals R, G and B, the signal controller 600 transmits the gate control signals CONT1 to the gate driver 400, and the processed image signals R', G', B', C, M and Y and the data control signals CONT2 to the data driver 500.

The gate control signals CONT1 include a scanning start signal STV for instructing to start scanning and at least a clock signal for controlling the output time of the gate-on voltage Von. The gate control signals CONT1 may further include an output enable signal OE for defining the duration of the gate-on voltage Von.

The data control signals CONT2 include a horizontal synchronization start signal STH for informing of start of data transmission for a group of subpixels, a load signal LOAD for instructing to apply the data voltages to the data lines D1-Dm, and a data clock signal HCLK. The data control signal CONT2 may further include an inversion signal RVS for reversing the polarity of

the data voltages (with respect to the common voltage Vcom).

Responsive to the data control signals CONT2 from the signal controller 600, the data driver 500 receives a packet of the image data R', G', B', C, M and Y for the group of subpixels from the signal controller 600, converts the image data R', G', B', C, M and Y into analog data voltages selected from the gray voltages supplied from the gray voltage generator 800, and applies the data voltages to the data lines D1-Dm.

The gate driver 400 applies the gate-on voltage Von to the gate line G1-Gn in response to the gate control signals CONT1 from the signal controller 600, thereby turning on the switching elements Q connected thereto. The data voltages applied to the data lines D1-Dm are supplied to the subpixels through the activated switching elements Q.

The difference between the data voltage and the common voltage Vcom is represented as a voltage across the LC capacitor CLC, which is referred to as a subpixel voltage. The LC molecules in the LC capacitor CLC have orientations depending on the magnitude of the subpixel voltage, and the molecular orientations determine the polarization of light passing through the LC layer 3. The polarizer(s) converts the light polarization into the light transmittance.

By repeating this procedure by a unit of the horizontal period (which is denoted by 1H and equal to one period of the horizontal synchronization signal Hsync and the data enable signal DE), all gate lines G1-Gn are sequentially supplied with the gate-on voltage Von during a frame, thereby applying the data voltages to all subpixels. When the next frame starts after finishing one frame,

the inversion control signal RVS applied to the data driver 500 is controlled such that the polarity of the data voltages is reversed (which is referred to as frame inversion). The inversion control signal RVS may be also controlled such that the polarity of the data voltages flowing in a data line in one frame are reversed (for example, line inversion and dot inversion), or the polarity of the data voltages in one packet are reversed (for example, column inversion and dot inversion).

Now, methods and devices of converting image signals according embodiments of the present invention will be described in detail.

First, methods of converting image signals are described in detail.

Hereinafter, image signals representing white, red, green, blue, cyan, magenta, and yellow colors are referred to as white, red, green, blue, cyan, magenta, and yellow signals and denoted by W, R, G, B, C, M, and Y.

The signal conversion converts a set of three input signals representing one of the second three primary colors (referred to as a target color) into a set of six output signals also representing the target color. Here, two conversion methods are suggested, a mixed color method and a pure color method. The pure color method represents any one of the second three primary colors only with the corresponding color signal, while the mixed color method represents the color with the corresponding color signal and other two of the first three primary color signals. In other words, the pure color method makes the five output signals zero other than the output color signal representing the target color, while the mixed color method makes other two of the first primary color signals nonzero.

Fig. 3 is a table for illustrating the two conversion method according embodiments of the present invention.

The first column indicates colors represented by image signals, the second column indicates grays of input signals, the third column indicates grays of output signals in the mixed color method, and the fourth column indicates grays of output signals in the pure color method.

It is noted in Fig. 3 that white color is represented by using all of six nonzero output signals for increasing the luminance.

Now, the mixed color method and the pure color method according to embodiments of the present invention will be described in detail with reference to Fig. 4.

Fig. 4 is a flow chart illustrating the conversion of the image signals.

First, the mixed color method is described in detail (401).

A set of three input color signals are inputted and classified into three level, maximum Mx, middle Md, and minimum Mn depending on their relative values or relative luminance represented by the signals (402).

The classified signals are then decomposed into six color components (403), which is illustrated in Fig. 5.

Referring to Fig. 5, the first three primary color signals R, G and B are represented as axes of the three dimensional color coordinates. For example, x, y, and z axes represent red, green, and blue signals R, G and B and the values of the signals are normalized. The cyan, magenta, and yellow signals C, M and Y have a zero component and two nonzero components having equal values.

In other words, a cyan signal C is made by adding a green signal G and a blue signal G such that it is complementary to the red color signal R, and it is represented by a coordinate (0, c, c). Similarly, magenta and yellow signals M and Y are represented by coordinates (m, 0, m) and (y, y, 0), respectively, and complementary to the green signal G and the blue signal B, respectively. Here, the complementary relation of two colors means that the addition of the two colors can result in white color. In Fig. 5, the coordinates of the white signal W are (w, w, w) and thus two color signals in a complementary relation can be added to generate white color.

The set of the input signals R, G and B represent a point (Mx, Md, Mn) in a color coordinate system like that shown in Fig. 5.

Extraction of the minimum Mn yields:

(Mx, Md, Mn)

= (Mn, Mn, Mn) + (Mx - Mn, Md - Mn, 0)

= (Mn, Mn, Mn) + (Md - Mn, Md - Mn, 0) + (Mx - Md, 0, 0)

= Mn(1, 1, 1) + (Md - Mn)(1, 1, 0)+(Mx - Md)(1, 0, 0). (a)

Considering the six color coordinates, Equation (a) is rewritten:

(Mx, Md, Mn)

= (Mn/3)[(1, 0, 0) + (0, 1, 0) + (0, 0, 1) + (0, 1, 1) + (1, 0, 1) + (1, 1, 0)]+[(Md - Mn)/2][(1, 0, 0) + (0, 1, 0) + (1, 1, 0)]+(Mx - Md)(1, 0, 0)(b)

Therefore,

(Mx, Md, Mn)

= (Mx - Md/2 - Mn/6)(1, 0, 0)+(Md/2 - Mn/6)(0, 1, 0)+(Mn/3)(0, 0, 1)+(Mn/3)(0, 1, 1)+(Mn/3)(1, 0, 1)+(Md/2 - Mn/6)(1, 1, 0).(c)

Equation (c) includes three coefficients, i.e., (Mx - Md/2 - Mn/6), (Md/2 - Mn/6), (Mn/3) and a maximum coefficient is determined (404).

For this purpose, the differences between the coefficients are calculated as follows:

$(Mx - Md/2 - Mn/6) - (Md/2) = Mx - Md \geq 0$, and

$(Md/2 - Mn/6) - (Mn/3)=(Md - Mn)/2 \geq 0$.

Accordingly, it is determined that the coefficient of (1, 0, 0), i.e., (Mx - Md/2 - Mn/6) is the maximum.

Next, a scaling factor is calculated (405).

The scaling factor S1 is given by a ratio of the maximum Mx of the input three-color signals to the maximum (Mx - Md/2 - Mn/6) of the above-calculated six color components.

Equation 1

$S1 = Mx/(Mx - Md/2 - Mn/6)$

Equation 1 shows that the scaling factor S1 is equal to or larger than one.

Equation 1 is established considering the adjustment of the maximum value of output six color signals. The scaling factor is multiplied to the coefficients obtained by Equation to obtain increments. The multiplication of the scaling factor conserves the order of the values of the image signals. The multiplication yields:

Equation 2

$Mx' = S1(Mx -Md/2-Mn/6)$;

$Md' = S1(Md/2 - Mn/6)$;

$Mn' = S1(Mn/3);$

$cMx' = S1(Mn/3);$

$cMd' = S1(Mn/3);$ and

$cMn' = S1(Md/2 - Mn/6),(2)$

where Mx', Md' and Mn' denote maximum, middle, and minimum values after the multiplication, respectively, and cMx', cMd' and cMn' denote the signals having a complementary relation to maximum, middle, and minimum signals.

Equation 2 is rewritten as follows:

Equation 3

$Mx' = Mx$

$Md' = (3Md - Mn)Mx/(6Mx - 3Md - Mn)$

$Mn' = 2MnMx/(6Mx - 3Md - Mn)$

$cMx' = 2MnMx/(6Mx - 3Md - Mn)$

$cMd' = 2MnMx/(6Mx - 3Md - Mn)$

$cMn' = (3Md - Mn)Mx/(6Mx - 3Md - Mn)(3)$

Equation 3 tells that the maximum, the middle, and the minimum input image signals R, G and B keeps their order the values and thus the output signals for second primary colors are also determined. Accordingly, the six color output signals are determined.

Next, the pure color method will be described in detail.

Like Equation (a),

(Mx, Md, Mn)

$= (Mn, Mn, Mn) + (Mx - Mn, Md - Mn, 0)$

$= (Mn, Mn, Mn) + (Md - Mn, Md - Mn, 0) + (Mx - Md, 0, 0)$

$= Mn(1, 1, 1) + (Md - Mn)(1, 1, 0)+(Mx - Md)(1, 0, 0).(d)$

Equation is rewritten like Equation (b):

(Mx, Md, Mn)

$= (Mn/3)[(1, 0, 0) + (0, 1, 0) + (0, 0, 1) + (0, 1, 1) + (1, 0, 1) + (1, 1, 0)]+(Md - Mn)(1, 1, 0) + (Mx - Md)(1, 0, 0).(e)$

It is noted that the coefficient for the second term (1, 1, 0) is different from that in Equation (b). That is, the second term in Equation (d) includes no coefficient for (1, 0, 0) and (0, 1, 0) for remaining only a signal for pure second primary color, and thus the coefficient for (1, 1, 0) is altered.

Equation (e) is rewritten with respect to the colors to yield:

(Mx, Md, Mn)

$= (Mx - Md + Mn/3)(1, 0, 0)+(Mn/3)(0, 1, 0)+(Mn/3)(0, 0, 1)+(Mn/3)(0, 1, 1)+(Mn/3)(1, 0, 1)+(Md - Mn + Mn/3)(1, 1, 0)(f)$

Among the three coefficients $(Mx - Md + Mn/3)$, $(Md - Mn + Mn/3)$, and $(Mn/3)$, the coefficient $Mn/3$ is the minimum and the larger one of the coefficients $(Mx - Md + Mn/3)$ and $(Md - Mn + Mn/3)$ depends on the values Mx, Md and Mn.

When $(Mx - Md + Mn/3) \geq (Md - Mn + Mn/3)$, the scaling factor S2 is determined by the same rule as that related to the mixed color method. That is, the scaling factor is a ratio of the maximum Mx of the input three-color signals to the maximum $/(Mx - Md + Mn/3)$ of the above-calculated six color components:

Equation 4

$S2 = Mx/(Mx - Md + Mn/3)(4)$

The multiplication of the scaling factor S2 to the coefficients yield the

output values as follows:

Equation 5

$$Mx'' = Mx$$

$$Md'' = 3MnMx/(3Mx - 3Md + Mn)$$

$$Mn''= 3MnMx/(3Mx - 3Md + Mn)$$

$$cMx''= 3MnMx/(3Mx - 3Md + Mn)$$

$$cMd''= 3MnMx/(3Mx - 3Md + Mn)$$

$$cMn''= (3Mn - 2Mn)Mx/(3Mx - 3Md + Mn)(5)$$

When $(Mx - Md + Mn/3) < (Md - Mn + Mn/3)$, the scaling factor S3 is also given by a ratio of the maximum Mx of the input three-color signals to the maximum $(Md - Mn + Mn/3)$ of the above-calculated six color components:

Equation 6

$$S3 = Mx/(Md - Mn + Mn/3)$$

The six color components are calculated by:

Equation 7

$$Mx3 = (3Mx - 3Md + Mn)Mx/(3Md - 2Mn);$$

$$Md3 = 3MnMx/(3Md - 2Mn);$$

$$Mn3 = 3MnMx/(3Md - 2Mn);$$

$$cMx3 = 3MnMx/(3Md - 2Mn);$$

$$cMd3 = 3MnMx/(3Md - 2Mn);\text{ and}$$

$$cMn3 = Mx$$

Since the mixed color method displays cyan by using green and blue signals G and B as well as a cyan signal C, the displayed cyan color has luminance higher than that displayed using the pure color method. On the

contrary, the pure color method displays a cyan color having higher chroma than the mixed color method since it uses only a cyan signal.

Now, a signal modifier for six color rendering according to an embodiment of the present invention will be described in detail with reference to Fig. 6.

Fig. 6 is a block diagram of a signal modifier according to an embodiment of the present invention, which may be integrated in the signal controller 600 shown in Fig. 1 or implemented as a stand-alone device.

Referring to Fig. 6, a signal modifier according to this embodiment includes a magnitude comparator 601, a decomposer 602, a scaler 603, and a signal extractor 604.

The magnitude comparator 601 compares the magnitudes (or grays) of image signals in a set of three three-color input signals, which include a red signal R, a green signal, and a blue signal B, and classifies each signal into the highest one (Mx), the middle one (Md), and the lowest one (Mn).

The decomposer 602 decomposes the set of the three-color input signals from the magnitude comparator 60 into a set of six six-color signal components.

The scaler 603 compares the six-color signal components from the decomposer 602 and determines the highest one among the six components. Thereafter, the scaler 603 calculates a scaling factor given by the ratio of the highest one (Mx) of the three input signals to the highest six-color component and calculates increments for the six-color components by multiplying the scaling factor to the six-color components.

The signal extractor 604 extracts six six-color output signals representing red, green, blue, cyan, magenta, and yellow colors based on the calculated increments from the scaler 603.

[EFFECT OF THE INVENTION]

The device and the method for converting three-color input image signals to six-color output image signals may provide increased luminance and concentration to a high quality TV.

Although preferred embodiments of the present invention have been described in detail hereinabove, it should be clearly understood that many variations and/or modifications of the basic inventive concepts herein taught which may appear to those skilled in the present art will still fall within the spirit and scope of the present invention, as defined in the appended claims.

[CLAIMS]

1. A method of converting image signals for a display device including six-color subpixels, the method comprising:

classifying three-color input image signals into maximum, middle, and minimum;

decomposing the classified signals into six-color components;

determining a maximum among the six-color components;

calculating a scaling factor; and

extracting six-color output signals.

2. The method of claim 1, wherein the three-color signals comprise red, green and blue signals.

3. The method of claim 2, wherein the six-color signals comprise red, green, blue, cyan, magenta, and yellow signals.

4. The method of claim 3, wherein the decomposition comprises:

expressing a predetermined number of terms of coordinates with coefficients.

5. The method of claim 4, wherein the coefficients comprise first to third coefficients expressed as the maximum, middle, and minimum, and the coordinates are assigned to the six-color signals.

6. The method of claim 5, wherein the six-color components comprises a first term expressed as a multiplication of the first coefficient and first to sixth coordinates, a second term expressed as a multiplication of the second coefficient and the first, second, and sixth coordinates, and a third term expressed as a multiplication of the third coefficient and the first coordinate.

7. The method of claim 5, wherein the six-color components comprise a first term expressed as a multiplication of the first coefficient and first to sixth coordinates, a second term expressed as a multiplication of the second coefficient and the sixth coordinate, and a third term expressed as a multiplication of the third coefficient and the first coordinate.

8. The method of claim 6 or 7, wherein the first to the third terms are further decomposed into the first to sixth coordinates to be expressed as a multiplication of fourth to ninth coefficients and first to sixth coordinates.

9. The method of claim 8, wherein the calculation of the scaling factor comprising:

determining a maximum among the coefficients; and

calculating a ratio of the maximum among the fourth to ninth coefficients and the maximum among the three-color signals to determine the scaling factor.

10. The method of claim 9, wherein the scaling factor is equal to or larger than one.

11. The method of claim 10, wherein the extraction of the six-color signals comprises:

multiplying the scaling factor to the fourth to ninth coefficients.

12. A device of converting image signals for a display device including six-color subpixels, the device comprising:

a signal controller converting three-color input signals into six-color output signals;

a gray voltage generator generating a plurality of gray voltages; and

a data driver converting into the six-color signals into data voltages

selected among the gray voltages and supplying the data voltages to the subpixels,

wherein the signal controller comprises:

a magnitude comparator comparing the three-color signals;

a decomposer decomposing the three-color signals into six-color components;

a scaler calculating a scaling factor based on signals from the magnituded comparator and the decomposer; and

a signal extractor multiplying the scaling fact to the six-color components.

13. The device of claim 12, wherein the three-color signals comprise red, green and blue signals.

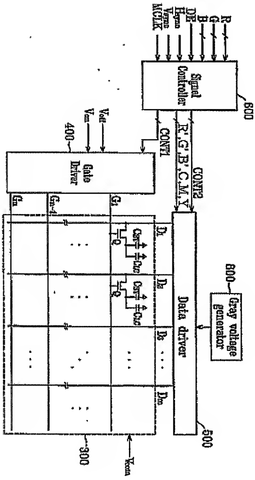
14. The device of claim 13, wherein the six-color signals comprise red, green, blue, cyan, magenta, and yellow signals.

15. The device of claim 14, wherein the scaling factor is defined as a ratio of the maximum among the six-color components and the maximum among the three-color signals

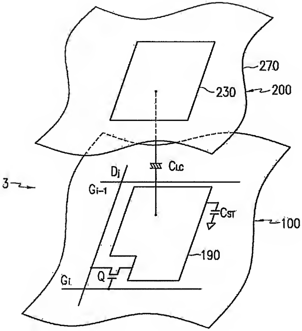
16. The device of claim 15, wherein the signal extractor obtains increments by multiplying the scaling factor to the six-color components.

[DRAWINGS]

[FIG. 1]



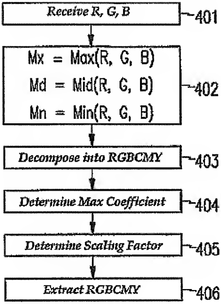
[FIG. 2]



[FIG. 3]

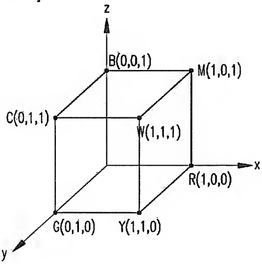
	input			mixed						pure					
	R	G	B	R	G	B	C	M	Y	R	G	B	C	M	Y
WHITE	255	255	255	255	255	255	255	255	255	255	255	255	255	255	255
RED	255	0	0	255	0	0	0	0	0	255	0	0	0	0	0
GREEN	0	255	0	0	255	0	0	0	0	0	255	0	0	0	0
BLUE	0	0	255	0	0	255	0	0	0	0	0	255	0	0	0
CYAN	0	255	255	0	255	255	255	0	0	0	0	0	255	0	0
MAGENTA	255	0	255	255	0	255	0	255	0	0	0	0	0	255	0
YELLOW	255	255	0	255	255	0	0	0	255	0	0	0	0	0	255

[FIG. 4]



Receive R, G, B
401
Mx = Max(R, G, B)
Md = Mid(R, G, B)
Mn = Min(R, G, B)
402
Decompose into RGBCMY
403
Determine Max Coefficient
404
Determine Scaling Factor
405
Extract RGBCMY
406

[FIG. 5]



z
B(0,0,1)
M(1,0,1)
C(0,1,1)
W(1,1,1)
x
R(1,0,0)
G(0,1,0)
Y(1,1,0)
y

[FIG. 6]